Everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents: a meta-analysis of randomised controlled trials

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Summary

Background **Bioresorbable coronary stents might improve outcomes of patients treated with percutaneous coronary interventions. The everolimus-eluting bioresorbable vascular scaffold is the most studied of these stent platforms; however, its performance versus everolimus-eluting metallic stents remains poorly defined. We aimed to assess the efficacy and safety of everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents in patients with ischaemic heart disease treated with percutaneous revascularisation.**

Methods **We searched Medline, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), scientific sessions abstracts, and relevant websites for randomised trials investigating everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents published or posted between Nov 30, 2006, and Oct 12, 2015. The primary efficacy outcome was target lesion revascularisation and the primary safety outcome was definite or probable stent (scaffold) thrombosis. Secondary outcomes were target lesion failure (the composite of cardiac death, target-vessel myocardial infarction, or ischaemia-driven target lesion revascularisation), myocardial infarction, death, and in-device late lumen loss. We derived odds ratios (ORs) and weighted mean differences with 95% CIs, and calculated the risk estimates for the main outcomes according to a random-effects model. This study is registered with PROSPERO, number CRD42015026374.**

Findings **We included six trials, comprising data for 3738 patients randomised to receive percutaneous coronary intervention with either an everolimus-eluting bioresorbable vascular scaffold (n=2337) or an everolimus-eluting metallic stent (n=1401). Median follow-up was 12 months (IQR 9–12). Patients treated with bioresorbable vascular scaffolds had a similar risk of target lesion revascularisation (OR 0·97 [95% CI 0·66–1·43]; p=0·87), target lesion failure (1·20 [0·90–1·60]; p=0·21), myocardial infarction (1·36 [0·98–1·89]; p=0·06), and death (0·95 [0·45–2·00]; p=0·89) as those treated with metallic stents. Patients treated with a bioresorbable vascular scaffold had a higher risk of definite or probable stent thrombosis than those treated with a metallic stent (OR 1·99 [95% CI 1·00–3·98]; p=0·05), with the highest risk between 1 and 30 days after implantation (3·11 [1·24–7·82]; p=0·02). Lesions treated with a bioresorbable vascular scaffold had greater in-device late lumen loss than those treated with a metallic stent (weighted mean difference 0·08 [95% CI 0·05–0·12]; p<0·0001).**

Interpretation **Compared with everolimus-eluting metallic stents, everolimus-eluting bioresorbable vascular scaffolds had similar rates of repeat revascularisation at 1 year of follow-up, despite inferior mid-term angiographic performance. However, patients treated with a bioresorbable vascular scaffold had an increased risk of subacute stent thrombosis. Studies with extended follow-up in a larger number of patients are needed to fully assess the long-term advantages of everolimus-eluting bioresorbable vascular scaffolds.**

Funding **None.**

Published **Online** November 16, 2015 http://dx.doi.org/10.1016/S0140-6736(15)00979-4

See **Online/Comment** http://dx.doi.org/10.1016/S0140-6736(15)00978-2

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Introduction

Contemporary high-performance metallic drug-eluting stents are the gold standard for percutaneous treatment of ischaemic heart disease.[1] However, late adverse events related to the stented segment continue to accrue, and evidence suggests that accelerated atherosclerosis inside the stent represents an important underlying mechanism.[2]

In the past decade, fully bioresorbable stents eluting anti-restenotic drugs have attracted substantial interest. Indeed, these platforms offer a transient arterial support until the elution process is completed, potentially avoiding late vascular consequences due to permanent metal constraints.[3] So far, two devices have received CE-mark approval: the Absorb everolimus-eluting bioresorbable scaffold (Abbott Vascular, Santa Clara, CA, USA) and the novolimus-eluting DESolve stent (Elixir Medical Corporation, Sunnyvale, CA, USA). Of these devices, the everolimus-eluting bioresorbable vascular scaffold—a balloon-expandable bioresorbable scaffold consisting of a poly-L-lactide backbone (150 µm in thickness) coated with a 1:1 mixture of poly-D,L-lactide and everolimus (8·2 µg/mm)—is the platform with the largest available preclinical and clinical evidence.[3] Preclinical and

imaging-based clinical findings have shown that this device has favourable healing characteristics, allows restored vasomotor function of the treated segment, and provides an increase in lumen calibre due to positive vessel remodelling once dissolved.[4] However, data from routine clinical practice suggest that it is associated with a somewhat higher rate of adverse events than occur with contemporary metallic drug-eluting stents.[5] In particular, rates of thrombosis after implantation of bioresorbable vascular scaffolds can be marginally greater.[6]

Findings from various randomised clinical trials[7–12] have shown similar mid-term outcomes between patients who receive everolimus-eluting bioresorbable vascular scaffolds and those who receive everolimus-eluting metallic stents. However, most of these trials were small and not adequately powered to assess clinical endpoints. Therefore, we undertook a meta-analysis of randomised trials investigating the efficacy and safety of everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents in patients with ischaemic heart disease treated with percutaneous revascularisation.

Methods

Search strategy and selection criteria

In accordance with PRISMA guidelines,[13] we searched Medline, Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), scientific sessions abstracts, and relevant websites (www.cardiosource.com, www.clinicaltrialresults.org, www.escardio.org, www.tctmd.com, www.theheart.org) for articles published or posted between Nov 30, 2006, and Oct 12, 2015, with no restrictions on language or publication status. We checked the reference lists from all eligible studies to identify additional citations. Search terms included the keywords and the corresponding MeSH terms for "bioresorbable stent(s)", "Absorb stent", "everolimus-eluting stent(s)", "trial", and "randomized trial". Studies eligible for inclusion had a randomised design, did analysis by intention to treat, and had a follow-up time of 6 months or longer. We excluded studies of comparisons other than everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents, and those with duplicated data.

Data extraction and assessment of risk of bias

Two investigators (SC and RAB) independently assessed publications for eligibility at title or abstract level, with divergences resolved by a third investigator (GN). Studies that met inclusion criteria were selected for further analysis. Freedom from bias was assessed for each study in accordance with the Cochrane Collaboration method,[14] on the basis of methodological items: adequacy of random sequence generation and allocation concealment, blinding, incomplete reporting of outcome data, selective presentation of outcomes, consistency of description of sample-size calculation, and disclosure of funding sources. We did not do formal quality score adjudication.[15]

Outcomes

The primary efficacy outcome was target lesion revascularisation. The primary safety outcome was definite or probable stent (scaffold) thrombosis. Secondary outcomes were target lesion failure (the device-oriented composite endpoint of cardiac death, target-vessel myocardial infarction, or ischaemia-driven target lesion revascularisation), myocardial infarction, death, and in-device late lumen loss at angiographic follow-up. All endpoints were assessed according to the intention-to-treat principle at the longest follow-up available and according to the definitions reported in the original trial protocols.

Statistical analysis

Odds ratios (ORs) and weighted mean differences with 95% CIs were used as summary statistics and were derived for the comparison of everolimus-eluting bioresorbable vascular scaffolds with everolimus-eluting metallic stents. Most of the commonly used meta-analytical methods can be biased when data are sparse, and the Peto method is the least biased and most powerful.[16] We used the Peto fixed-effects model to calculate pooled ORs for categorical variables and the inverse variance fixed-effects model to calculate pooled mean differences for continuous variables. We also calculated the risk estimations for main outcomes according to a random-effects model. To account for possible imbalance between treatment and control group sizes within trials, the risk estimates for rare categorical outcomes (<50 events) were further calculated according to Barnard's mid-p exact method with the use of EXACTMA (version 0.3) software.[17] In trials in which no events were reported within groups, the treatment effect could not be assessed.

We used the Breslow-Day χ^2 test and the I^2 statistic to test heterogeneity between studies. I^2 values of less than 25%, 25–50%, or more than 50% indicated low, moderate, or high heterogeneity, respectively.[14] In addition to statistical tests, we visually estimated funnel plots to evaluate the possibility of publication bias for primary outcomes.[18] An influence analysis, in which meta-analysis estimates are computed with omission of one study at a time, was done for primary outcomes. We did a sensitivity analysis to assess the extent to which several covariates—the proportion of patients with diabetes or presenting acute coronary syndrome at admission, the vessel size, the proportion of complex lesions (type B2/C) treated, or the frequency of postdilation after implantation of a bioresorbable vascular scaffold—might have affected the risk estimates for primary outcomes. Additionally, we addressed the time dependence of risk estimates for early definite or probable stent thrombosis (acute ≤24 h, subacute >24 h, and ≤30 days) associated with bioresorbable vascular scaffolds or metallic stents.

We did the main statistical analysis with RevMan (version 5.3) and Stata (version 11.2). This study is registered with PROSPERO, number CRD42015026374.[19]

Role of the funding source
There was no funding source for this study. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Figure 1 shows a flow diagram of the study selection process. We included six trials,[7–12] comprising data for 3738 patients randomised to receive percutaneous coronary intervention with either everolimus-eluting bioresorbable vascular scaffolds (n=2337) or everolimus-eluting metallic stents (n=1401). The appendix shows the main characteristics of the trials. Patients randomised to receive a bioresorbable vascular scaffold were treated with the Absorb stent.[4] Patients randomised to receive a metallic stent were treated with either a cobalt–chromium stent (Xience V, Xience Prime, or Xience Expedition, Abbott Vascular, Santa Clara, CA, USA; n=1321) or a platinum–chromium stent (Promus Element, Boston Scientific, Natick, MA, USA; n=80). One trial[9] included a third treatment group of patients randomised to receive a biolimus-eluting stent (BioMatrix Flex, Biosensor, Newport Beach, CA, USA); we excluded data for this treatment group because we deemed it irrelevant to the study research question. All trials but one[9] had a multicentre design, with two trials[8,9] enrolling patients with acute myocardial infarction. In three trials[7,9,11] the primary endpoint consisted of angiographic measures of efficacy (namely, late lumen loss), and in one trial[8] the primary endpoint consisted of imaging measures of efficacy (namely, healing score); the remaining trials[10,12] were powered to detect composite clinical outcomes. One trial,[7] powered to assess angiographic outcomes, reported an interim analysis of clinical endpoints after 1 year of follow-up; we used this data for the present report. Angiographic follow-up was planned in four studies[8–11] between 6 and 13 months, and the proportion of patients with invasive surveillance data ranged from 85% to 94%.

The appendix describes in detail the definitions used for outcomes. All interventions were done in accordance with standard of care, including optimisation of stent deployment or use of intravascular imaging techniques, at the operators' discretion or according to protocols. Among all trials, predilation was done in 2420 (98%) of 2466 lesions treated with bioresorbable vascular scaffolds and 1423 (95%) of 1494 lesions treated with metallic stents; postdilation was done in 1588 (64%) and 770 (52%) lesions, respectively. Anticoagulation during percutaneous coronary intervention was accomplished through administration of either unfractionated heparin or bivalirudin in all cases. After coronary interventions, aspirin was recommended indefinitely, whereas thienopyridines were prescribed for a period ranging from 6 to 12 months. All trials reported the adherence to prescribed antiplatelet therapy within treatment groups up to the longest follow-up available (range 80·5–97% adherence). All patients received standard cardioactive treatments as required. The appendix reports risk of bias among studies.

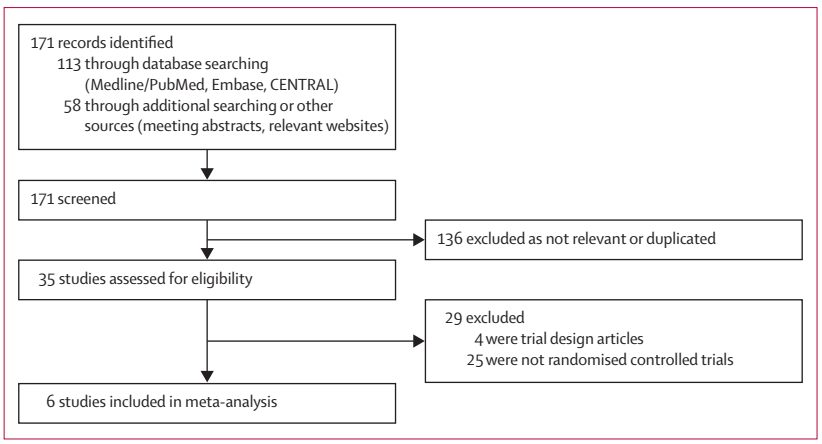

***Figure 1*: Flow diagram of the study selection process**

Patients enrolled were mainly men, with a median age of 62·3 years (IQR 58·6–65·0), and nearly a quarter had diabetes (table). Overall, roughly a third of patients presented with acute coronary syndrome at the time of index percutaneous coronary intervention (table). Overall, mean baseline diameter stenosis was 70·8%, reference vessel diameter was 2·70 mm, and the length of lesions treated was 13·4 mm (table). Roughly 70% of lesions had a complex morphology (table). 3713 (99%) patients had data available for assessment of clinical outcomes. Median follow-up was 12 months (IQR 9–12).

The primary efficacy outcome of target lesion revascularisation was recorded in 116 (3%) patients (figure 2). Risk of target lesion revascularisation was similar between groups (figure 2). Ischaemia-driven target lesion revascularisation arose in 99 (3%) patients; the risk was similar between patients treated with a bioresorbable vascular scaffold and those treated with a metallic stent (64 [3%] *vs* 35 [3%] patients; OR 1·13 [95% CI 0·74–1·71], p=0·58; I^2=0%, $p_{heterogeneity}$=0·89). The primary safety outcome of definite or probable stent thrombosis was recorded in 36 (1%) patients (figure 2). Patients treated with a bioresorbable vascular scaffold had a higher risk of definite or probable stent thrombosis than those treated with a metallic stent (figure 2). Risk estimates computed according to the mid-p exact method confirmed this significantly heightened risk (OR 2·20 [95% CI 1·01–5·55], p=0·046; $p_{heterogeneity}$=0·65). Definite stent thrombosis occurred in 31 (1%) patients. Risk of definite stent thrombosis was higher, albeit non-significantly so, in patients treated with a bioresorbable vascular scaffold than in those treated with a metallic stent (25 [1%] *vs* six [<1%] patients, OR 1·98 [95% CI 0·94–4·16], p=0·07; I^2=0%,

See Online for appendix

	ABSORB China[11]	ABSORB II[7]	ABSORB III[12]	ABSORB Japan[10]	EVERBIO II[9]	TROFI II[8]
Patients						
Randomised, n	480	501	2008	400	158 (240*)	191
Age (years)	57·4 (10·5)	61·2 (10·0)	63·5 (10·5)	67·2 (9·5)	65 (11·0)	58·6 (10·1)
Men	343/475 (72%)	385 (77%)	1415/2006 (71%)	309 (77%)	125 (79%)	157 (82%)
Diabetes	115/475 (24%)	120 (24%)	640/2006 (32%)	144 (36%)	30 (19%)	32 (17%)
Insulin dependent	41/475 (9%)	36 (7%)	215/2006 (11%)	35 (9%)	5 (3%)	8 (4%)
Dyslipidaemia	192/475 (40%)	385 (77%)	1732 (86%)	328 (82%)	94 (59%)	115 (60%)
Acute coronary syndrome at admission	306/475 (64%)†	105 (21%)†	523/2007 (26%)†	48 (12%)†	55 (35%)	191 (100%)
Dual antiplatelet therapy						
New P2Y12 inhibitor	5/475 (1%)	NR	719/1990 (36%)	NA	91 (58%)	127 (66%)
Clopidogrel	470/475 (99%)	NR	1271/1990 (64%)	393 (98%)‡	67 (42%)	65 (34%)
Lesions						
Randomised, n	503	546	2098	412	208 (325*)	193
Diameter stenosis (%)	64·8 (12·8)	59·5 (11·5)	65·6 (12·1)	64·6 (11·0)	80·5 (15·7)	89·7 (15·2)
Reference vessel diameter (mm)	2·81 (0·44)	2·61 (0·39)	2·66 (0·45)	2·75 (0·45)	2·58 (0·65)	2·81 (0·49)
Length (mm)	14 (4·93)	13·8 (6·55)	12·8 (5·6)	13·4 (10·8)	NA	13·1 (7·17)
Type B2/C	369/502 (74%)	254/543 (47%)	1462/2089 (70%)	313/409 (77%)	67/208 (32%)	192/192 (100%)

Data are mean (SD) or n (%), unless otherwise indicated. Denominators have been provided when they differ from the total number of patients or lesions. NR=not reported. NA=not available. *Totals in parentheses include patients or lesions in the biolimus-eluting stent group. †Unstable angina only. ‡Ten (2·5%) patients received ticlopidine.

Table: **Baseline characteristics**

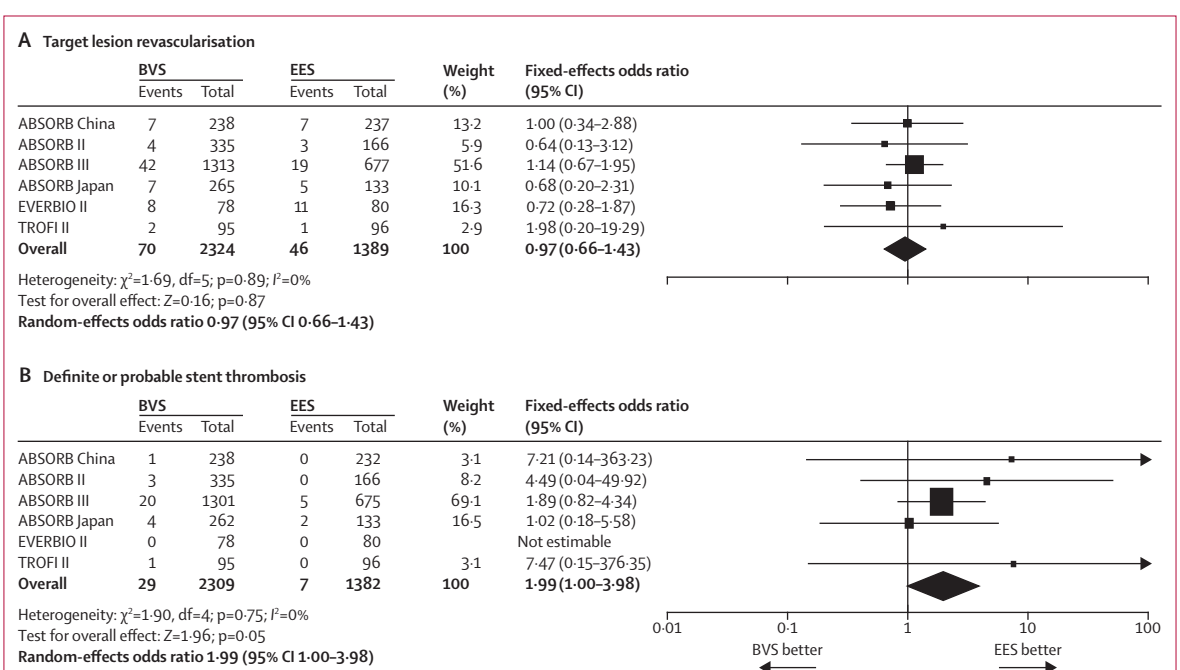

Figure 2: **Risk estimates of primary outcomes for BVS versus EES**
Forest plots show results for target lesion revascularisation (A) and definite or probable stent thrombosis (B). BVS=bioresorbable vascular scaffold. df=degrees of freedom. EES=everolimus-eluting stent.

$p_{heterogenetiy}$=0·85). Risk estimates computed according to the mid-p exact method confirmed these findings (OR 2·17 [95% CI 0·94–5·96]; p=0·07; $p_{heterogeneity}$=0·79). Compared with patients treated with metallic stents, patients treated with bioresorbable vascular scaffolds had a significant time-dependent risk of early (≤30 days after implantation) definite or probable stent thrombosis (acute, OR 0·36 [95% CI 0·07–1·71]; p=0·21; I^2=39%; $p_{heterogeneity}$=0·20; subacute, OR 3·11 [1·24–7·82]; p=0·02; I^2=0%; $p_{heterogeneity}$=0·92; $p_{interaction}$<0·0001).

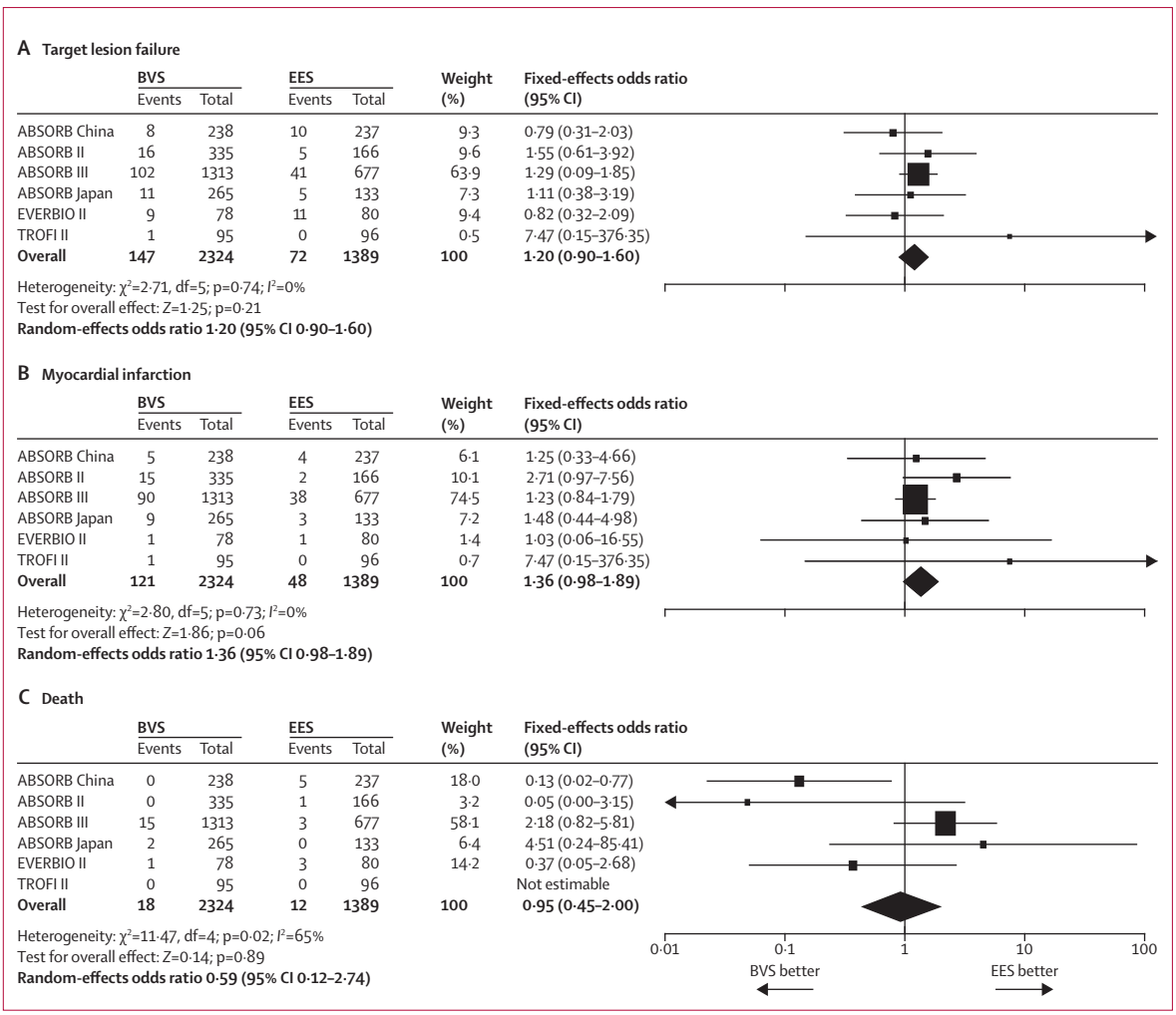

***Figure 3*: Risk estimates of secondary outcomes for BVS versus EES**
Forest plots show results for target lesion failure (A), myocardial infarction (B), and death (C). BVS=bioresorbable vascular scaffold. df=degrees of freedom. EES=everolimus-eluting stent.

Target lesion failure, the main secondary outcome, occurred in 219 (6%) patients (figure 3). Risk of target lesion failure was similar between patients treated with bioresorbable vascular scaffolds and those treated with metallic stents (figure 3). Myocardial infarction was reported in 169 (5%) patients (figure 3). Patients treated with bioresorbable vascular scaffolds had a higher risk of myocardial infarction than those treated with metallic stents, although the risk did not differ significantly between groups (figure 3). The risk estimate did not change after exclusion of trials[8,9] with less than 12 months of follow-up (119 [6%] of 2151 patients in the bioresorbable vascular scaffold group *vs* 47 [4%] 1213 patients in the metallic stent group; OR 1·35 [95% CI 0·97–1·88]; p=0·07; I^2=0%, $p_{heterogeneity}$=0·56). 30 (1%) patients died (figure 3). Risk of death was similar between patients treated with bioresorbable vascular scaffolds and those treated with metallic stents, although there was significant heterogeneity for this outcome (figure 3). Estimates from the random-effects model showed a similar risk, but with wider confidence intervals (p=0·50; figure 3). Risk estimates computed with the exact-p method confirmed these findings (OR 0·94 [95% CI 0·45–2·05]; p=0·88; $p_{heterogeneity}$=0·89).

In trials[8–11] with per-protocol angiographic surveillance, 1265 (96%) of 1316 lesions were available for quantitative analyses after a median of 10·5 months (IQR 7·5–12·5; figure 4). Lesions treated with bioresorbable vascular scaffolds had significantly greater in-device late lumen loss than those treated with metallic stents (figure 4). Heterogeneity for this risk estimate was moderately high (figure 4). Risk estimates with the random-effects model showed similar results, with wider confidence intervals (p=0·004; figure 4). Lesions treated with bioresorbable vascular scaffolds also had greater in-segment late lumen loss (p=0·01; figure 4).

We derived funnel-plot distributions of primary efficacy and safety outcomes from the standard error of the

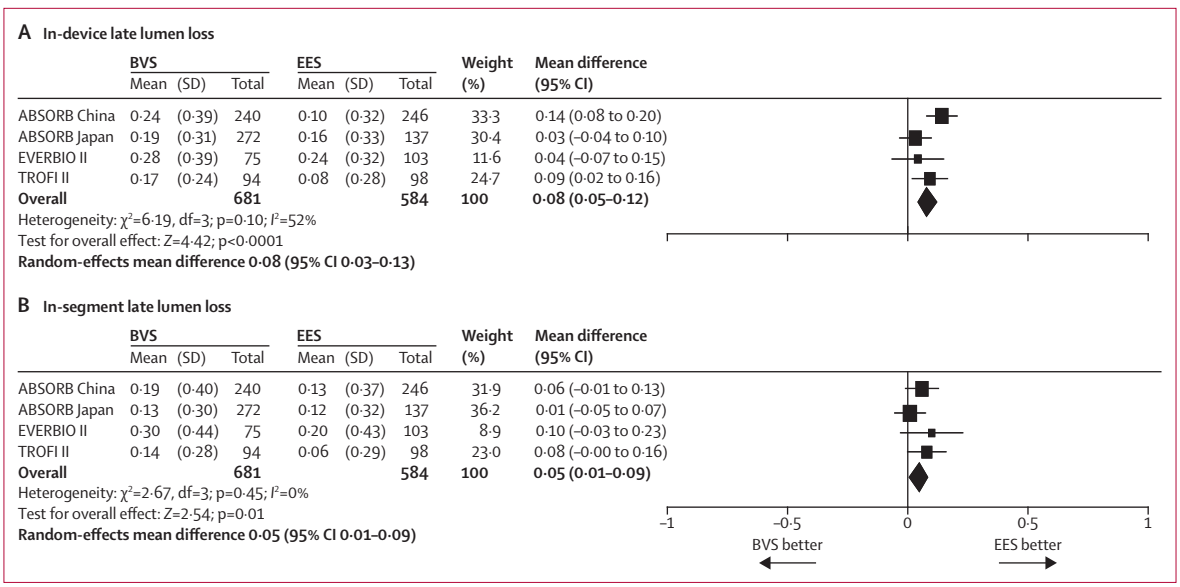

Figure 4: **Risk estimates of angiographic secondary outcomes for BVS versus EES**
Forest plots show inverse-variance-weighted mean differences for in-device (A) and in-segment (B) late lumen loss. BVS=bioresorbable vascular scaffold. df=degrees of freedom. EES=everolimus-eluting stent.

natural logarithm OR plotted against the OR of target lesion revascularisation and definite or probable stent thrombosis, respectively (appendix). The absence of bias due to small study effects was confirmed both visually and mathematically. Additionally, influence analysis showed that no study significantly changed the summary OR for primary outcomes (appendix). Risk estimates for both target lesion revascularisation and definite or probable stent thrombosis were not significantly dependent on the proportion of patients with diabetes ($p_{interaction} \geq 0 \cdot 23$) or the proportion with acute coronary syndrome at admission ($p_{interaction} \geq 0 \cdot 69$), on vessel size ($p_{interaction} \geq 0 \cdot 84$), on the proportion of complex lesions treated ($p_{interaction} \geq 0 \cdot 38$), or on frequency of postdilation in patients in the bioresorbable vascular scaffold group ($p_{interaction} \geq 0 \cdot 33$).

Discussion

To our knowledge, this is the first meta-analysis of randomised trials investigating the efficacy and safety of everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents in patients with ischaemic heart disease treated with percutaneous revascularisation. Our findings show that bioresorbable vascular scaffolds had a similar risk of repeat revascularisation as metallic stents, a higher risk of stent (scaffold) thrombosis at 1 year of follow-up, and an inferior mid-term angiographic performance. The risk estimation for target lesion revascularisation was not affected by either the proportion of patients with diabetes or unstable clinical presentation, or by lesion features.

The primary benefit of biodegradable versus metallic stents is expected to emerge several years after index percutaneous coronary interventions, when the elution of anti-restenotic drug is completed and the bioresorbable scaffold is dissolved.[4] Our finding of at least similar efficacy versus the existing best-in-class drug-eluting stent at 12 months is important. However, this result was achieved in a highly selected population. Of note, three of the trials[10–12] included in this meta-analysis (enrolling >75% of overall patients) were designed to support the regulatory approval of the everolimus-eluting bioresorbable vascular scaffold in the USA, China, and Japan, and included mainly stable patients with single de-novo non-complex target lesions, excluding those patients treated with percutaneous coronary interventions who had a higher risk for device failure. Furthermore, data from large registries of bioresorbable scaffolds used in routine clinical practice have shown a rate of adverse events higher than the rate we observed after use of contemporary metallic drug-eluting stents.[6] For this reason, the availability of the results of large-scale, all-comers, randomised clinical trials (ClinicalTrials.gov, numbers NCT01858077,[20] NCT02173379) will shed more light on the relative efficacy of everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents in higher-risk populations.

The present meta-analysis showed a higher time-dependent risk of definite or probable stent thrombosis in patients treated with a bioresorbable vascular scaffold versus those treated with a metallic stent. This result merits careful discussion. First, our analysis confirmed the good safety profile of everolimus-eluting metallic stents, with an overall rate of definite or probable stent thrombosis of 0·5% in nearly 1500 patients after 12 months. Second, the absolute risk increase of

definite or probable stent thrombosis with a bioresorbable vascular scaffold was modest. Third, the rate and the timing of definite or probable stent thrombosis in patients treated with percutaneous coronary interventions who received a bioresorbable vascular scaffold was consistent with that reported in other studies, with most events occurring within 30 days.[6] Of note, in trials included in our study, compliance to prescribed dual antiplatelet therapy throughout the period after percutaneous coronary intervention was consistently more than 80%. Whether the higher risk of subacute stent thrombosis with bioresorbable vascular scaffolds is attributable to implantation technique and lesion selection remains to be determined. Indeed, although the proportion of patients with postdilation was higher in the bioresorbable vascular scaffold group, the final results in terms of in-device minimum lumen diameter were still inferior to those for metallic stents. Work is ongoing to optimise the implantation technique for the bioresorbable vascular scaffold, which is expected to improve clinical outcomes. In this respect, a more liberal use of intravascular imaging to guide scaffold expansion might be important to optimise acute results, as already reported.[21] Additionally, whether further iteration of the everolimus-eluting bioresorbable vascular scaffold[4] will have a favourable effect on rates of early thrombotic events is still open to question.

We noted evidence of inferior angiographic performance of the bioresorbable vascular scaffold versus the metallic stent after a median follow-up of 10 months. This finding is consistent with those from previous reports.[22,23] The significantly worse angiographic outcome in patients who received bioresorbable vascular scaffolds than in those who received metallic stents was recorded in the trials[8,9] in which per-protocol angiographic surveillance was done at 6–9 months (p=0·02 for in-device and p=0·01 for in-segment late lumen loss). By contrast, bioresorbable vascular scaffolds had similar angiographic efficacy to metallic stents in the trials[10,11] in which per-protocol invasive surveillance was done at 12 months or later (p=0·12 for in-device and p=0·16 for in-segment late lumen loss). Despite the different angiographic efficacy of the bioresorbable vascular scaffold versus the metallic stent, the overall revascularisation rates were not affected. However, the availability of late angiographic data from ongoing trials will further clarify the adaptive response of the coronary vessel wall after implantation of a bioresorbable vascular scaffold, and its possible effect on clinical outcomes.

Our study has several limitations. First, in view of the fairly highly selected population enrolled in the original trials, the total number of events was low, despite pooling of data for roughly 4000 patients. This number of patients represents the largest patient population analysed in this type of study and is likely to remain the best evidence base for assessment of everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents for the foreseeable future. Moreover, the generalisability of the present findings to routine practice, and the strength of conclusions regarding differences in rare events such as stent thrombosis, remain unclear. Second, this meta-analysis summarised primary results of randomised trials comparing everolimus-eluting bioresorbable vascular scaffolds with everolimus-eluting metallic stents, which had a median follow-up of 1 year. Extension of follow-up beyond this timepoint in the original trials will remain crucial to assess the potential late benefits and safety of the bioresorbable vascular scaffold once resorption is at advanced stages or nearly completed. Third, this meta-analysis is based on aggregate data and shares the possible limitations of the original trials. Differences in the enrolled populations (one trial[8] [9% of all patients included] enrolled exclusively patients with myocardial infarction) and length of follow-up (two trials[8,9] [5% of all patients included] with <12 months of follow-up) did not lead to statistical heterogeneity in the overall estimates. Fourth, the scarcity of systematic investigation of angina recurrence after implementation of everolimus-eluting bioresorbable vascular scaffolds versus everolimus-eluting metallic stents in the original trials precluded further analysis of this specific outcome in the present study. Fifth, this study focused on only one type of bioresorbable stent (the Absorb bioresorbable scaffold); therefore, our findings do not apply to other bioresorbable stent platforms. Finally, the assessment of publication bias was based on a small number of trials, which prevents a definitive conclusion about the existence of potential bias due to small study effects.

The results of our meta-analysis suggest that, at 1 year, patients treated with percutaneous coronary intervention who receive an everolimus-eluting bioresorbable vascular scaffold have a similar requirement for repeat revascularisation as those who receive an everolimus-eluting metallic stent, despite greater late lumen loss. The rate of definite or probable stent thrombosis was two-times higher with the bioresorbable vascular scaffold than with the metallic stent after 1 year. Studies with extended follow-up in a larger number of patients are needed to fully assess the expected long-term advantages of everolimus-eluting bioresorbable vascular scaffolds.

Contributors

SC did the data analysis and, with RAB, wrote the first draft of the manuscript. SC, GN, MF, and AK conceived and designed the study. SC, RAB, GN, SK, JW, JR, and TK acquired the data. SC, RAB, GN, SK, HS, MF, and AK revised the manuscript for important intellectual content. All authors approved the manuscript for final submission.

Declaration of interests

RAB has received fees from B Braun Melsungen AG, Biotronik, and Boston Scientific, outside the submitted work. TK is member of the advisory board of Abbott. AK holds patents in relation to drug-eluting stent technologies, outside the submitted work. All other authors declare no competing interests.

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